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# THESIS

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An Analysis of the Acquisition  
of the Penguin Missile

by

David E. Hough

• • •

December 1987

Thesis Advisor:

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An Analysis of the Acquisition  
of the Penguin Missile

by

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Submitted in partial fulfillment of the  
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

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December 1987

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## ABSTRACT

Program Managers within the Department of Defense are under increasing pressure to conform to Congressional mandates and Department of Defense Directives to ensure standardization of weapons with the NATO allies. There are many unique problems to be considered prior to making a decision.

This thesis will review the Penguin Missile acquisition, the problems encountered and how they were handled and the alternatives available to the Program Manager to handle these problems.

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# I. INTRODUCTION

## A. DISCUSSION

The rapid rise in the costs of weapons systems since World War II has led the armed services of most countries to seek the lowest cost alternative that will meet their defense requirements. The United States has been one of the major suppliers of weapons and technology, to meet these defense needs, since the end of that war. The US has striven to maintain a technological edge over its potential enemies vice attempting to match numerical superiority. Defenders of this policy have traditionally taken a "you get what you pay for" approach toward the issue of technological superiority, while those intent on reducing the the high cost of defense have attempted to enforce strict price controls. Recent studies have shown that these two diverse positions may be more incompatible than anyone previously though. We may not be able to sustain the very industries that are essential to maintaining this technological edge and enforce a least cost method of defense. [Ref. 1: p. 9]

The upward spiral of costs has increased the pressure on all branches of the Department of Defense to hold down the costs of procuring new systems. It has also forced them to look beyond domestic sources to acquire items vitally needed for the national defense. Since the 1970's program managers have been admonished to not only sell abroad, but consider alternatives to domestic purchase of weapons, such as co-development and outright purchase of foreign made weapons. [Ref. 2: p. 1]

A plethora of US laws, regulations and DOD directives drive the acquisition process. These numerous directions on procurement are changing as rapidly as the technology contained in modern weapons, complicating program management. This diverse number of sources of directions force the Program manager to become an expert in International Laws and Treaties in order to effectively manage acquisition in the foreign marketplace.

The Department of Defense has been reluctant to enter the unfamiliar arena of the international marketplace in search of items to fulfil its needs, and as such is a newcomer in the challenges of the foreign marketplace. Legal constraints such as the Buy America Act have hampered efforts in looking abroad for additions to the US arsenal. This condition has been further exacerbated by the "Not-Invented-Here" syndrome so prevalent in the Armed Services. Worries over lines of supply, access to technology, lack of spares and political instability continue to place hurdles in the path of the program manager.

In contrast to the barriers put up against the purchase of foreign weapons and products, many in Congress and the Department of Defense have moved to open the US marketplace to foreign companies . This would allow these companies to sell products developed overseas to US Forces. A major piece of legislation to open markets was the Fair Trade Act of 1979. It provides a medium for the implementation of agreements negotiated in the Tokyo round of Multi-lateral Trade negotiations. Covering approximately eight billion dollars worth of DOD business, this Act opens US and foreign markets to government-to-government sales in an equitable manner.

Also serving to facilitate the "Two-Way Street" are Memorandum of Understanding (MOU's). These may be specific, covering one or more programs entered into by the signatories, or general, covering broad categories of commodities. As defined in DOD Directive 2010.6, a Memorandum of Understanding is "An international agreement between two or more parties. . . usually refers to government to government agreements negotiated between allied defense agencies and signed by officials of the executive branch of governments, usually at or below the ministerial level". [Ref 3 :p. 3] These agreements provide for a long term and equitable balance of trade and technology taking into account the relative technological levels of such procurement.

## **B. SCOPE OF THE THESIS**

This thesis is limited to an analysis of the problems encountered and the lessons learned in the acquisition of the foreign produced weapons systems with emphasis on the acquisition of the Penguin anti-ship missile system. Specifically this thesis attempts to look at the problems associated with procuring major weapon systems from foreign sources, and how these were handled in the Penguin program.

## **C. METHODOLOGY**

This research was conducted in three forms and was cumulative in nature. First, a review of current literature, instruction, directives, and guidance on foreign acquisition was conducted. Second, interviews with persons connected with the Harpoon Office, PMA-258, designated to handle the Penguin acquisition, at Naval Air Systems Command were conducted. The third step was to analyze the results of steps one and two in an effort to identify potential problem areas in the acquisition of foreign produced weapon systems.

## **D. THESIS STRUCTURE**

This thesis is divided into five chapters. Chapter I provides an introduction and outlines the environment. Chapter II presents the history of co-development projects both international and US, and purchases of foreign weapons by the US since the Korean War. Chapter II also delineates the effects that NATO RSI policies have had on new programs. Chapter III provides an overview of the Penguin Missile and the program to date. Chapter IV reports the problems and lessons learned of implementing the DOD policies dealing with foreign weapon procurement, with emphasis on its effects on the acquisition of the Penguin missile. Chapter V provides Conclusion and Recommendations. A list of Acronyms is provided in Appendix A.

## II. BACKGROUND

### A. HISTORICAL PRECEDENCE

In the commercial marketplace, America lives in a world of imported goods. Cars from Germany, Japan, France, Korea, Yugoslavia, Great Britain and Italy. Electronic goods from Mexico, Japan and Korea. "Made in . . ." has become what the consumer expects. The United States has become the world target for their exports. The consumer would be hard pressed to remember a time when "Made in America" encompassed his entire shopping cart.

Prior to the Korean War, United States Industry was extremely knowledgeable about foreign sources of raw materials, but only in cases where manufactured items were not available from domestic sources did US Industry venture overseas in search of finished goods. The decades that followed have seen rapid change in the makeup of industry, until today many industries no longer exist in the US and foreign sources provide the only venue for obtaining even necessities.

Military arms sales and transfers in the United States, date almost from the time the fledgling country declared its independence from England. Generally however, this has been limited to sales, for the US seldom ventured beyond an indigenous industrial complex for the acquisition of military hardware. Since the Korean War the United States has provided billions of dollars in military assistance to foreign countries, in the assumption that the provision of this assistance would assure the security, and economic well being of these countries. This was not altogether altruistic in nature, as this also helped secure basing rights and over-flight rights in these countries, spread democracy in the world and contain communism. [Ref. 4: pp. 1-3]



The Department of Defense has been slow to enter the foreign market place due to internal prejudices against foreign weapons and worries over such issues as lines of supply and the ability of foreign manufacturers to supply needed spare parts in a timely fashion. This continues to plague the services as they attempt to implement new directives that require them to look at alternatives both foreign and domestic in filling requirements for new systems, but also restrict what and how they may acquire and how they may acquire them.

## **B. ACQUISITION OVERVIEW**

World War II took the world from simple weapons into the era of modern technology, and did so with a rapidity here-to-for unknown. With this rapid change in technology came an even greater change in the cost of these weapons of war. In 1946 an F4U Corsair fighter cost the Navy approximately \$45,000. By 1986 the cost of an F-14 had broken the \$30,000,000 level and the cost of the high tech weapons continues to grow at an astronomical rate.

Europe realized that with the escalating costs involved in national defense, no country could afford to maintain an arms industry that would be able to provide for all of its needs. They understood that countries must cooperate in designing, producing and fielding weapons. Out of this realization came a number of multi-national companies and projects. Table 2-1 provides a list of some of the major collaborative efforts that have been of significance in the past two decades.

From this collaborative spirit has come the Panavia Tornado, The Alpha Jet Trainer, and the Roland anti-tank missile. In table 2-2 we can see that since 1957 there has been a total of 47 international co-development agreements in Europe/Western Alliance. Out of this total, the US has been involved in 22 projects, but only 5 of these projects have reached a production status for US forces.

## 1. Protectionism

Restrictions in foreign trade can be traced back to a piece of landmark legislation, The Buy America Act of 1933. Enacted in the depth of the Great Depression, this act received wide acceptance in all sectors of American life. Implemented in Executive Order 10582, this Act specifically favored the purchase of American products and services. Looking at sections 10a-10d 41 U.S.C.

"Notwithstanding any other provision of law, and unless the head of the department or independent establishment concerned shall determine it to be inconsistent with the public interest, or the cost to be unreasonable, only such unmanufactured articles, materials, and supplies as have been manufactured in the United States substantially all from articles, materials or supplies mined, produced, or manufactured, as the case may be, in the United States in sufficient and reasonable available commercial quantities and of a satisfactory quality." [Ref.5 : p. 9]

It further set forth a formula for determining whether a foreign good would be purchased over a similar domestic product. Under this the provisions contained in the act, a 6 percent differential was added to the price of a product from a foreign manufacturer. If the price of the foreign good was still lower, the Government could purchase the good, but was not obligated to do so even though it was the low bidder. This Act applied only to the Federal government, not to State or Local governments.

The Department of Defense took a more narrow interpretation of The Buy America Act, applying the criteria of the Balance of Payments Program. Foreign goods were evaluated using the six percent criterion used in evaluating Non-DOD goods and services or by using an alternate criterion obtained by adding fifty percent of the purchase price (exclusive of import duties). The DOD agency evaluating the bid was required to select the method that resulted in the greater price to be evaluated [Ref. 1: p. 14-15].

**TABLE 2-1**  
**Major European Consortiums 1960 - 1987**

<u>CONSORTIUMS</u>	<u>PROJECT</u>	<u>COUNTRIES</u>
1. SEPECAT	Jaguar Attack A/C	UK, France
2. Airbus Industries	A300, A310, A320 A340	UK, France, Italy, Germany
3. Concorde	Concorde	UK, France
4. PANA VIA	Tornado Fighter	UK, Germany Italy
5. PAH	PAH-2	France, Germany
6. Alpha Jet	Alpha Jet Trainer	France, Germany
7. Euromissile	Roland	Germany, France
8. IAE	V2500	UK, France Japan, US Germany
9. CFM	CFM 56	France, US
10. Eurofighter	Eurofighter	UK, Germany Italy

Source: [Ref. 6: pp. 1-250, Ref. 7: pp. 1-300]

**TABLE 2-2**  
**MAJOR INTERNATIONAL CO-DEVELOPMENT**  
**1958-1987**

	Total	NATO
1. A/C and Components	21	1
2. Missiles	10	6
3. Ground Force Equip.	9	3
4. Naval Craft	2	2
5. Electronics and S.E.	5	4
TOTAL	47	16

Source: [Ref. 6 : pp. 1-250,Ref.7: pp. 1-300]

Through numerous amendments the Buy America Act has lost much of its impact to the point that it has very little effect on current DOD acquisitions. However this does not lessen the emotional fervor of those that still support such measures.

In a protectionist fashion, Congress has continually heaped greater restrictions on procurement from foreign sources in annual Defense Appropriation Bills. The use of appropriated funds has been withheld for the purchase of food, clothing, fabrics and specialty metals.[ Ref. 1: p. 15] In only two of the last years did Congress lift the restrictions on specialty metals. Domestic industrial pressure has been significant enough to be instrumental in maintaining the other restrictions in annual appropriations bills, such as restrictions on vehicles, computer equipment, and aircraft rework contracts.

## **2. The Changing Environment**

The Congress and the Department of Defense are becoming aware of the advantages both economically and militarily of foreign procurements. Administration policy under both the Carter and Reagen Administrations have stressed close arms cooperation with our NATO allies, specifically the goals espoused in RSI.

One piece of legislation having a great impact on opening the "Two-Way Street" has been the Trade Agreements Act of 1979. This Act implements Title III of the agreements negotiated in the Tokyo round of ongoing multi-lateral trade negotiations. This permits sources in countries adhering to the code contained in Title III to compete for government contracts in signatory countries. This Act also provides for waiver of the Buy America Act and the balance of payments differential. This is an historic opening of government markets and a movement of the signatory governments to true international free trade relatively free of domestic restrictions for government buying.

Moving in the direction of removing restrictions and freing up government to government trade, the implementation of General and Specific Memorandum of Understanding (MOU's) have greatly facilitated the broadening of opportunities for sources in each country, to compete for defense business of the other on the same basis as domestic sources.

### **C. RATIONALIZATION, STANDARDIZATION, AND INTEROPERABILITY**

The original North Atlantic Treaty contained a provision that the member nations seek to improve the effectiveness of their forces by seeking to move to common weapons or ones that would be compatible. This received very little attention until the 1970's when operational commanders realized that often troops could not even communicate with one another as their communication equipment was not compatible.

During the Carter Administration a great deal of effort centered on the Concept of Rationalization, Standardization, and Interoperability (RSI). Under pressure from European members of the NATO Alliance to balance the trade in armament, the United States reluctantly agreed to evaluate European systems to fill its requirements. This would open American markets to European armaments and fulfil section three of the NATO Treaty to ensure compatibility of US and Allied Forces.

In May 1977, President Carter attended the NATO summit in London. Addressing the members, he emphasized the need for improved cooperation within the Alliance in the development, procurement and fielding of defense equipment. At the summit he stated that:

1. The United States must be willing to promote genuine two-way transatlantic trade in defense equipment.
2. He had instructed the Secretary of Defense to seek increased opportunities to buy European defense equipment where this would mean more efficient use of Allied resources.
3. He would work with Congress to this (the above) end. [Ref. 8: p.419]

The Defense Appropriation Act of 1977 contained the "Culver-Nunn" amendment that stated:

"It is the policy of the United States that equipment procured for use by personnel of the Armed Forces of the United States in Europe. . .be standardized or at least interoperable with equipment of other members of the North Atlantic Treaty Organization."

The resulting trade agreements opened the flow of arms and technology between NATO Alliance members giving rise to the term "two-way street". This is a reference to the United States buying technology and weapons from Europe as well as the Europeans purchasing arms from the US.

It would be helpful here to clearly explain the various terms of RSI as they are used in the Department of Defense and outlined in DOD Directive 2010.6.

1. Rationalization: "Any action that increases the effectiveness of Alliance forces through more efficient and effective use of defense resources committed to the alliance."
2. Standardization: "The process by which member nations achieve the closest practicable cooperation among forces; the most efficient use of research, development, and production resources; and agree to adopt on the broadest possible

basis the use of: (1) common or compatible operation, administrative and logistics procedures; (2) common or compatible technical procedures and criteria; (3) common , compatible or interchangeable supplies, components, weapons or equipment; and (4) common or compatible tactical doctrine with corresponding organization compatibility."

3. Interoperability: "the ability of systems, units or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together."

To implement RSI, it further goes on to state:

"Accordingly the Department of Defense shall initiate and carry out methods of cooperation with its Allies in defense equipment acquisition to improve NATO's military effectiveness for all participants. . . The goal is to achieve standardization of entire systems, where feasible, and to gain the maximum degree of interoperability throughout Alliance military forces." [Ref. 9: pp. 2-6]

## D. CONFLICTS

The United States and it's European partners have not only had problems in applying RSI to mutual defense requirements, but have had problems with determining equity in sharing the burdens of the NATO Alliance. The United States has continually upheld figures that show that it maintains an "unfair" proportion of the total NATO expenditures.

As can be seen in Table 2-3 from 1960 to 1970 the US share of NATO defense spending remained fairly stable at almost 75 percent of the total, but by 1975 the distribution of spending had shifted dramatically with the US share falling to just under 60 percent.

Arguments as to equity in the alliance continue to be bantered about with both sides producing reports to show that they are the ones shouldering the majority of the burden. This problems will continue to be exacerbated in the era of declining budgets and trade imbalances.

With the US Congress viewing the figures through rather jaundiced eyes, protectionist legislation continues to be produced. Included in the Fiscal Year 1988 Defense Authorization Bill are a number of legislative measures to "protect" domestic sources of supply from "unfair" foreign competition. These combined with the Fair Trade Act of

1979 and the Buy America Act of 1987 further complicates the analysis if foreign systems for the Program Manager.

**Table 2-3**  
**DEFENSE SPENDING BY COUNTRY, 1960 - 1980**

<u>(U.S. \$ BILLIONS)</u>				
<u>Country</u>	<u>1960</u>	<u>1970</u>	<u>1975</u>	<u>1980</u>
Belgium	.4	.7	2.0	3.7
Britain	4.6	6.0	11.1	24.4
Denmark	.2	.4	.6	1.4
France	3.9	6.0	14.0	20.2
West Germany	2.9	6.2	16.1	25.1
Greece	.2	.4	1.4	1.8
Italy	1.1	2.4	4.7	6.6
Luxembourg	.0	.0	.0	.1
Netherlands	.5	1.1	3.0	5.2
Norway	.2	.4	.9	1.6
Portugal	.1	.4	1.1	.9
Turkey	.2	.4	2.2	2.9
<u>Canada</u>	<u>1.7</u>	<u>1.7</u>	<u>3.0</u>	<u>4.2</u>
<u>NON U.S. TOTAL</u>	<u>16.0</u>	<u>26.1</u>	<u>60.4</u>	<u>98.1</u>
<u>United States</u>	<u>45.4</u>	<u>76.5</u>	<u>89.0</u>	<u>142.7</u>
US Expenditures as a share of all NATO (%)	73.9	74.6	59.6	59.3

Source:[Ref.10:pp.26-27]



### III. THE PENGUIN MISSILE

#### A. HISTORY OF THE PENGUIN MISSILE

The Penguin Missile was developed in the 1960's by the Norwegian Defense Research Establishment in conjunction with Kongsberg Vapenfabrik with technical assistance from the United States Navy Bureau of Naval Weapons. initially this missile was to provide for coastal defense from naval craft in response to a Royal Norwegian Navy requirement. It had to be capable of integration with the small and medium sized naval craft used in coastal defense.

The missile first became operational in 1972 with deployments aboard Norwegian "Storm" and "Snoegg" class attack craft. The Penguin Mk1 thus became one of the first operational surface-to-surface, anti-ship missiles in the Free World. This early missile was relatively cheap, used many off the shelf components and was fully autonomous after leaving the firing craft. It integrated a relatively simple infrared seeker, a Bullpup Mk19 warhead (US manufacture) and a rather simple solid propellant booster into a formidable weapon.[Ref. 11: pp. 29-30]

In 1974 a new development program was started to take advantage of the numerous technological advances that had taken place since the completion of the Penguin Mk1 program. Completed in 1979, this resulted in the Penguin Mk2. The Penguin Mk2 enjoyed significant improvements in range, seeker reliability, and seeker modes.

From 1977 to 1983 the United States Navy conducted a technical and operational evaluation of the Penguin to evaluate its potential for employment aboard the 65 foot Mk3 Patrol Boat; Project 573-OT-II and Project 775. Penguin was not procured for use on the Mk3 Patrol craft , but out of that evaluation came a number of recommendations that will be incorporated in the Penguin Mk2 Mod 7 missile that is being procured for the LAMPS Mk

III helicopter. Additional changes will be besides those required for integration with the helicopter. A number of these changes are shown in section B of this chapter and Appendix B.

The requirement for a helicopter launched anti-ship missile to be incorporated in the LAMPS Mk III is outlined in OR #017 - 05 -84. One item of interest here is that the operational requirement specifies that the Penguin missile fulfil the requirement for this system. Although unclassified sources don't discuss the reasoning behind this decision, one can only conclude that the testing that took place prior to th issuance of OR #017 - 05 - 84 concluded that the Penguin was the appropriate system to fulfil this need.

## **B . THE MISSILE CONFIGURATION**

The Penguin missile to be procured is a modification of the Penguin Mk2 currently being procured by the Royal Norwegian Navy. As mentioned earlier, it will incorporate a number of changes, not only to increase reliability and range, but changes to allow air-launch and and satisfy the requirements of the US Navy Insensitive munitions program. As listed in the Memorandum of Understanding (MOU) these changes include:

1. Development of detachable fins and folding wings to facilitate shipboard storage.
2. Modification of the missiles guidance section to allow for air-launch .
3. Integration of the MK2 Mod 5 seeker to the Mk2 Mod 7 missile.
4. Integration of a new or modified fuze, fuze booster and warhead that satisfies US Navy insensitive munitions requirements.
5. Rocket motor modifications or a new rocket motor including the incorporation of a Safe and arming device to satisfy US Navy insensitive munitions requirements.

As currently defined, the Penguin Mk2 Mod 7 will be an air-to-surface weapon capable of being launched from the SH-60B LAMPS Mk III helicopter. Its characteristics are listed in Table 3-1.

**Table 3-1**

**MISSILE CONFIGURATION**

-ROCKET	Solid Propellant Booster and Sustainer
-RANGE	15-18 NM (Depending on launch altitude)
-WEIGHT	850 lbs
-LENGTH	117 inches
-DIAMETER	11 inches
-WING SPAN	56 inches
-WARHEAD	104 lbs
-SEEKER	Infrared

Source: [Ref. 7: p. 300]

The Navy will purchase 193 missile and 16 additional missiles for RDT+E. Flyaway cost is estimated to be approximately \$428,000 per missile with a total program cost per missile of \$976,000 per missile. [Ref. 12: p. 2]

## IV. PENGUIN: A CASE FOR FOREIGN WEAPONS ACQUISITION?

### A. INTRODUCTION

Acquisition in the 1980's can be best described as a complicated process embroiled in a multi-faceted environment. Besides the plethora of regulations dealing with acquisition, the Program Manager attempting to pilot his program must be intimately familiar with a sea of regulations, laws, directives and International Treaties dealing with foreign acquisition. Some of these directives date from the early twentieth century, some were enacted during the execution of the program; all have a profound effect.

Additionally, the internal biases that may exist also affect the Program Office further complicating the efforts to establish and then manage the acquisition of a system. These biases may range from the familiar "Not-Invented-Here" syndrome to fears of supply lines being cut off and fears of political instability in the countries supplying armaments and spare parts.

International acquisition is not only the purchase of military armaments and hardware in the international marketplace, it is a highly charged and political process. Dealing not only with the military establishment of two or more countries, but with the bureaucracies of the countries involved. Dealing with these governing bureaucracies can be a long process even in a very small and simple acquisition let alone a program dealing with hundreds of millions of dollars.

What problems and pitfalls may a Program Manager encounter in the enactment of a foreign acquisition? This chapter while not all inclusive will examine a number of the areas that pose risks for a Project Office, how they were dealt with in the Penguin program and how they might be handled in other programs.

## **B. TECHNICAL DATA TRANSFER**

The transfer of technology between countries has been and will continue to be a highly charged and emotional issue. Who owns the technology? What does the money paid buy? The questions are limitless.

Traditionally the US has put restrictions on the technology contained within the weapon systems it sells abroad or licences for production abroad. The US sold production rights to the J79 engine to Israel to power F-4 fighter aircraft purchased by Israel and for use in a derivative of the Mirage fighter manufactured in Israel. However, when Israel desired to export the mirage derivative, the KFIR, the US turned down export licences for the engines. No engine, no plane sale. Be that as it may, the US has striven for complete transfer of all technology contained in new weapons systems and complete freedom of usage of that technology.

### **1. Technical Data Package**

Is the transfer of a complete data package necessary to the successful acquisition or employment of a foreign system? From a service perspective, it is highly important that the technical data package contain full and complete information on the technology contained in the system and on the production processes involved. It should also contain information on the maturity of the weapons system. [Ref 13: p. 44] Historically, incomplete information has presented problems in the employment and co-production of weapons, delaying the fielding of the armaments and creating a myriad of re-engineering problems. [Ref. 13: p. 103]

In his brief history of the French '75', Malone [Ref. 13: pp. 93-108] discusses some of the problems inherent in the transfer of technical data from France to the United States for licensed production.

1. Problems with drawings; European views used in the manufacturing process did not coincide with American drawings and had to be redone to allow production.
2. Working models of the gun did not coincide with the drawings provided to American planners.

3. Translating specifications to allow manufacture was a time consuming process and occasionally didn't translate literally.
4. Production processes used by the French were not adaptable to the mass manufacturing capabilities of US industry resulting in the redesign of numerous parts.

The problems encountered in the Roland program were similar to the experience in the French '75' purchase and serve to show some of the problems possible.

The Program Manager should be aware that there is no European counterpart to MIL-D-1000 which specifies how drawings are to be made, the level of the drawings and the structure, so that a drawing can be traced back to its subcomponent, component, and system. Further compounding the problems is the differing interpretation of standards in Europe and the United States. The phrase "standard finish" for example has no direct counterpart in the US.

Pertinent to the selection of a foreign system is the problem of metric vs inches. If a foreign system is selected, the PM must decide whether to retain the system as a metric system or convert it to the US system of measurement. If the decision is made to retain the metric system, the interface of the system with other US systems that are manufactured using the US system of measurement is worthy of note.

The translation of drawings, standards and specifications is a monumental and complicated task that can cause delays in production and become a major cost factor in the program. This may involve over 20,000 drawings, 4000 specifications, 10,000 standards and can cost upwards of \$20 million.

In approaching this problem in the Penguin program, the primary vehicle chosen to incorporate the rights to technology and its transfer to the US was the Memorandum of Understanding (MOU) [Ref. 14: sec. VII]. In the MOU, the rights that both countries have to the technical data, computer software, inventions, patents and copyrights are specified and is further elaborated on in the contract for the program.

## 2. Configuration Control

Configuration control in the case of the Penguin has been simplified because the Norwegian standard as outlined in Norwegian Instruction F-052-1020 is based on the principles of DOD-STD-480. The Penguin is to be retained as a metric system. It also meets NATO RSI goals since the Penguin Mk2 Mod3 missile from which the Mk2 Mod7 is derived, is in use by the Navy's of Norway, Greece, Turkey and Sweden. One interesting sidelight is the transfer to the Norwegians of all technology and production rights for changes made to the missile under this program.

The language used in the MOU and the contract should preclude problems encountered in other recent programs, most notably the procurement by the US Army of production rights to the Roland II guided missile [Ref 13: p. 47]. Much can be learned from the hard lessons of the past and these have been incorporated to a large extent in Penguin.

### C. SOURCING

There are three basic methods for sourcing weapons acquired from foreign sources

[Ref. 13: pp. 23-24]:

1. "Direct purchase of an ally's weapons system permits the purchasing state to avoid the R+D costs of developing a similar system and the expense of establishing domestic production base. Production under a single manager can result in longer production runs, thus achieving a more efficient economy of scale, and it insures equipment standardization between buyer and seller. The limitations of this approach are negative balance of payments effects (unless offset by other military or non-military trade), domestic employment losses, and the risk of relying on a foreign country for logistics support."
2. "Competitive R+D with licensed coproduction is the approach to standardization currently favored by the Defense Department. Legislation passed by Congress in 1976 endorsed this approach and expressed the sense of the Congress that coproduction would minimize the potential economic hardships of standardization (particularly the loss of domestic employment) and increase the survivability of the Alliance's production base in time of war. The coproduction approach achieves most military advantages of equipment commonality."
3. "Cooperative R+D, with two or more states teaming up to design common equipment from scratch, is being employed extensively in current European joint ventures. However, this approach has been somewhat discredited in the United States by some bad experiences in the past, most notably the aborted MBT-70 tank program."

In the acquisition of foreign produced weapons there is often only one source of the item, whether it is a government acquisition or a commercial purchase. In these cases it would be impractical if not entirely impossible to attempt to compete the contract.

Often embroiled in reams of paperwork, the sole sourcing of a foreign produced system or acquiring the rights to a foreign system, highlights the procurement politically. Sourcing of foreign systems also has its own specific sets of regulations that must be adhered to. This can be a time consuming and costly process involving a lengthening of the time to acquire and field any new system. If the system is to be procured by direct purchase from a single source, "justification for other than full and open competition" must be done, but this is often quickly approved in the case of foreign acquisitions to facilitate the approval of a system requirement.

How have these alternatives been handled in the acquisition of the Penguin missile and what effects have been encountered in the course of the Penguin Program ?

To pave the way for the Penguin acquisition, a study of off the shelf systems comparing Penguin, Hellfire, AS 15TT, Sea Skua, Maverick, Marte, Harm, Harpoon and Exocet was conducted. This study evaluated these systems on the basis of weight, range, type of guidance and release mechanism [Ref 15: p. 1]. Out of this study came the Operational Requirement specifying the need for Penguin.

Specification of the required system alleviated many of the problems involved in the procurement process. Since the RNON was only one source for Penguin; Sikorsky was the only source for the required modifications to the LAMPS Mk III aircraft; and IBM the only source for software modifications, contracting was simplified. This relegated the sole source justification requirement to simple process of submitting the required paperwork.

The sourcing decision in the case of the Penguin was relatively simple due to the relatively small number of missiles to be procured and the low dollar value of the program.



The Penguin will be a direct purchase, however the US Navy and the Royal Norwegian Navy will cooperate on the changes necessary to adapt the missile to US Navy peculiar requirements while it would have been possible to use competitive R+D with licensed coproduction, this was an unattractive alternative from an economic stand point.

It should be remembered as previously stated, the acquisition of foreign produced armaments is simplified, with regard to sourcing, when the candidate system is manufactured or can be procured from only one source. In the Penguin acquisition it can be seen that sourcing may be further simplified if all competing systems can be eliminated prior to the issuance of the Operational Requirement.

The sourcing issue must be evaluated according to program needs, costs and operational requirements. There is no clear cut answer and each program must be evaluated according to its own requirements. In the case of Penguin, the best alternative was chosen to be direct purchase.

#### **D. FINANCING**

After selection of a system, nothing is more emotionally charged and politically sensitive as the financing of military purchases. In this era of reduced DOD budgets, control of finances is of paramount importance to the Program Manager. [Ref. 16: p. 1]

The opportunities for problems in this area on any acquisition are legion and the pitfalls in a foreign acquisition are even greater. Requirements for purchase using local foreign currency, changes in exchange rates, and inability to control costs at the manufacturers site can have significant effects on the cost of a system, sometimes a positive effect, but more often than not a negative effect. These should be approached up front at the initiation of a new system.

## 1. Currency Requirements

Contracts entered into for a foreign acquisition must be priced and paid for in local currency unless an international agreement provides for payment in US dollars or the contracting officer determines that such use would be produce an inequitable or inappropriate situation [Ref. 17: p.25-8.2]. This caveat allows room for the Program Manager to determine in concert with the Contracting Officer whether the purchase of a system would best be done in local currency or in US currency.

Original estimates for the Penguin program indicated total costs to be 172.1 million dollars. By August 1985, these estimates had risen to 204 million, an increase of 31.9 million. These increases were primarily associated with changes in RDT+E and WP,N. Increases of nearly 20% in total program costs are significant, but these increases do not include changes due to differences in exchange rates.

At the outset of the Penguin program, exchange rate of Dollars to Kroners was set at 8.9 to 1. Applying this to the program cost of 204 million, assuming all costs to be incurred in the purchase would be done in Norway, the program in 1985 would have been 1815.6 million Kroners. By November 1987 the exchange rate, reflecting changing economic condition was 6.44 to 1. Since the program was priced out in Kroners, the program has grown to 282 million, an increase of 78 million just on the fluctuation of exchange rates alone.

Obviously the PM would not have sufficient information to predict such fluctuations at the beginning of a major new system, but he must be aware of these changes and should try to ensure adequate appropriations to purchase local currency needed to make payments. The PM should also be aware that when the local currency increases in value against the dollar that a violation of the Anti-Deficiency Act could occur [Ref. 17: p. 25-9].

The area of financing and costs is particularly fraught with problems and should be approached with caution.

## **2. Monitoring Costs**

The monitoring of costs, especially in the case of direct purchase can be difficult. Foreign manufacturers are reluctant to include clauses that would allow US personnel to directly monitor activities and the costs incurred in a program forcing the Program Manager to rely on figures provided by the manufacturer or by foreign government involved in the purchase.

The FAR places responsibility for the determination of cost support on the Contracting Officer. If he or the Program Manager are not satisfied they are to seek support from US Government activities.

The Royal Norwegian Navy (RNON) will provide the US with cost data for Penguin . Project Officers designated by the RNON and the USN will jointly monitor schedule, cost, and technical performance. While US personnel with appropriate clearances will be given access to Norwegian activities, the US contract is with the RNON, not, Kongsberg Vapenfabrik, the missile manufacturer and as such the USN will not have direct access to the manufacturers cost data.

## **E. THE POLITICAL ARENA**

This is the least defined and hardest to control area in any acquisition and is the source of of great emotional debate. It is often well beyond the control of the PM and may be the "make-or-break" factor in many acquisitions.

In the case of the Penguin program this is the possible end of the program. The House Appropriations Committee recommended a provision in the 1988 Defense Appropriations Bill prohibiting the importing of goods and services from Kongsberg Vapenfabrik. Kongsberg is the builder of the Penguin missile. There may be a waiver of this prohibition

by Congress on a case-by-case basis if the Secretary of Defense notifies Congress that the transaction is vital to the National Security [Ref. 18: p. 11].

The political arena goes far beyond the obvious problems of dealing with the bureaucracies of the two nations to the heart of the military establishments involved. Resistance to the influx of foreign technology arises often from concerns of the adequacy of foreign technology; lines of supply; dependability; RSI and the lack of control over the manufacturer.

Seeking a political solution to NATO RSI goals has been viewed as imperiling US Research and Development efforts, US corporate profits and military technology. Continued efforts in Congress to limit foreign competition for US government contracts have been offset by DOD efforts to reduce cost and implement RSI and Administration efforts at free trade in the international arena.

The 1988 Defense Authorization Bill contains no less than ten measures that the Department of Defense considers as protectionist, including restriction on vehicle purchases, and preferences in the awarding of DOD contracts to domestic sources.

During the next decade the factor that will continue to exert the greatest influence on program management, in the sensitive political area, will be RSI. Continuing emphasis on laws and regulations have established the US goal to achieve greater standardization of equipment within the alliance will dictate that all programs be evaluated in the light of RSI. This is documented in DOD directives and Sec Nav directives and provides the PM with guidance as to evaluating possible areas of co-development and licensed production.

## **F. LOGISTICS**

Though not peculiar to foreign acquisitions, logistics has been receiving increased attention from R+D to system retirement. The logistics support costs of a system can often equal or exceed initial procurement costs. Logistics has been defined as:

"The science of planning and carrying out the movement and maintenance of forces. In its most comprehensive sense, logistics pertains to those aspects of military operations which deal with (a) design and development, acquisition, storage, movement, distribution, maintenance, evacuation, and disposition of material; (b) movement, evacuation, and hospitalization of personnel; (c) acquisition or construction, maintenance, disposition of facilities; and (d) acquisition and furnishing of services."

[Ref. 19: p. 401]

In its broadest sense, logistics is the Life Cycle Cost of a weapons system, viewing it "from cradle to grave." With the increasing complexities of systems, reduced budgets, and limited resources it is essential that a new system be looked at on an integrated basis. Logistics must be looked at when evaluating the system during development to ensure a balance is achieved between the prime mission equipment and its related support.

With foreign systems that are purchased "off-the-shelf", much of this analysis has already been done, but must be re-evaluated for "hidden" costs and needs for the system. Integral with this evaluation is the determination of who is to provide spares support, determining if spares are best attained domestically or from the original manufacturer. Test equipment, training of personnel, contractor support, initial provisioning, interim support period, publications, transportation to the US, all these must be addressed in evaluating the candidate system.

The economics of Life Cycle Costing as previously mentioned has serious implications for the cost of a program and as such should be addressed fully in all major program documents such as the MOU, the Acquisition Plan and the Contract.

Logistics for Penguin will be handles jointly by the RNON and USN. The MOU states that "The RNON and USN will when negotiated and contracted for. . .prepare logistics support policies, plans and documentation." This combined with the open

exchange of documentation called for sets the tone for the logistics support plan and the maintenance plan. Further elaboration on Life Cycle Cost of the system is contained in the Acquisition Plan. Cost estimates for the program have factored in a 15% pipeline for missiles to and from depot maintenance and for the firing of four test missiles per year.

## V. CONCLUSIONS

### A. CONCLUSIONS

The Program Manager is faced with an ever changing environment in the acquisition of new systems. This is further complicated by the challenges of entering the foreign marketplace.

Traditionally the United States has shied away from procuring armaments from overseas sources. Reinforced by legislation such as the Buy America Act, weapons have been accepted only if they bore a "made in the US" label. Service bias has precluded the PM from becoming proficient at dealing with foreign governments as a customer.

The arena is changing as the effects of RSI, the Fair Trade Act of 1979 and other General Agreements on Trade and Tariff (GATT) continue to exert influence on the marketplace.

With the cost of modern weapons rising at an astronomical rate no country can afford to go it alone. The economics of modern weapons development cries out for the expansion of multi-national weapons development. The United States being a late comer to international weapons acquisition will have to rush to catch up with its European counterparts.

The lessons learned in the Penguin program can be applied to future foreign acquisition projects. The handling of technology transfer can be used as a model for ensuring full and complete transfer of technical data. Reviewing the areas evaluated in this thesis brings out the following:

1. Technical data transfer must be addressed fully and completely in the Memorandum of Understanding, and again in the contract and the Acquisition Plan. This is a critical area that must receive a great deal of attention prior to program initiation. The Program Office

must know what its needs are now or will be further into the program as it matures and ensure that this area is given the highest priority.

2. Sourcing must be evaluated not only in regards to the operational requirement, but need to be evaluated in the light of Research and Development and production desires or requirements. This can be simplified if addressed early in the program cycle by specifying the item in the Operational Requirement.

3. Financing in an era of shrinking Defense Budgets will continue to receive increasing scrutiny. When buying from foreign sources it may appear that the Program Manager is locked into a requirement to purchase in local currency, however there are ways around this requirement. These alternatives should be evaluated prior to signing the Memorandum of Understanding, but should surely be evaluated prior to signing of the contract.

4. The political arena is pivotal to the successful accomplishment of a foreign acquisition. With the current climate emphasizing Rationalization, Standardization and Interoperability, the Program Manager is encouraged to enter into co-development and licensing arrangements as well as outright purchase of foreign (NATO) produced armaments. While there are detractors, the emphasis currently is in increasing RSI, encouraging the PM to "get the most bang for the buck" and buy it from NATO sources if it will meet the need.

5. Logistics will continue to receive increasing attention as planners look not only to reduction of procurement costs but reducing total Life Cycle Costs. Evaluation of tradeoffs and factoring the cost must be done and given as great a priority as system performance. The costs involved in logistics are varied, numerous and multi-disciplinary, as such it requires the PM to have the proper personnel to evaluate the proposal and address the issues inherent here.



To ensure that the finest weapons are available at the lowest cost, the PM must aggressively pursue the goals enumerated in RSI. In the manner the US can continue to field weapons that are responsive to future needs.

## **B. SUMMARY OF RESEARCH QUESTIONS**

1. What is the scope of the contract? The Penguin contract includes the basic contract for 197 missiles from the Royal Norwegian Navy Material Command. It is for delivery of the missiles and associated support equipment, test equipment, and technical data. The contract does not include supplemental contracts to Sikorsky and IBM for the conversion of the Lamps MK III helicopter and software respectively. These are covered in separate contracts.

2. What effect will Royal Norwegian Material Command royalty costs have on the program? There was no unclassified material dealing with this specifically, but since the exchange rate has changed, causing increases in the program, it should be anticipated that royalty costs that will also be paid in Kroners will cause an additional increase in program costs.

3. What effect will the declining exchange rate have on overall program costs? What contingency plans have been made/should have been made? As can be seen in Chapter IV, the declining exchange rates have significantly affected overall program costs, increasing them almost 100%. This is a case that would have required almost clairvoyance on the part of the Program Manager and the Contracting Officer to anticipate. When this program was initiated the dollar was strong against almost all currencies world-wide, and the dramatic drop in the value of the dollar could not have been anticipated by even the most informed Program Offices. This also points out the need to be aware of the possible contingencies and plan accordingly, opting to pay in dollars or possibly fund the program

early to pay prior to purchase. Most of all, the Program Manager needs to be aware of this area prior to entering into direct purchase vice licensed production.

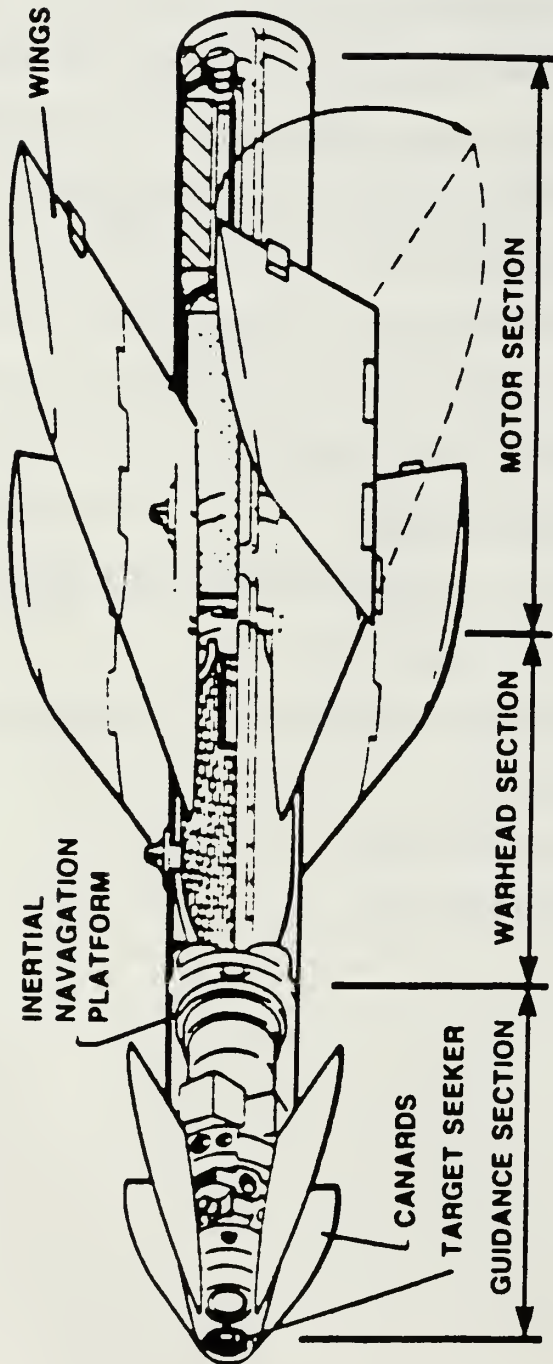
4. How will configuration control be handled? The Penguin will remain a metric system. The problem involved in reengineering the missile to the American system of measurement would be cost prohibitive and be against current DOD thinking to bring all new systems in as metric systems.

5. USN must deal with RNON from a contractual viewpoint, not the actual missile manufacturer, Kongsberg Vapenfabrik. What type of problems have been anticipated and how are they to be managed? It appears from a search of the data available that no problems were anticipated, or if they were they were not addressed in the unclassified data available on the program. The MOU and the other materials available only address access to Kongsberg facilities, not dealing with company personnel or with problems that might arise during the period of the contract.

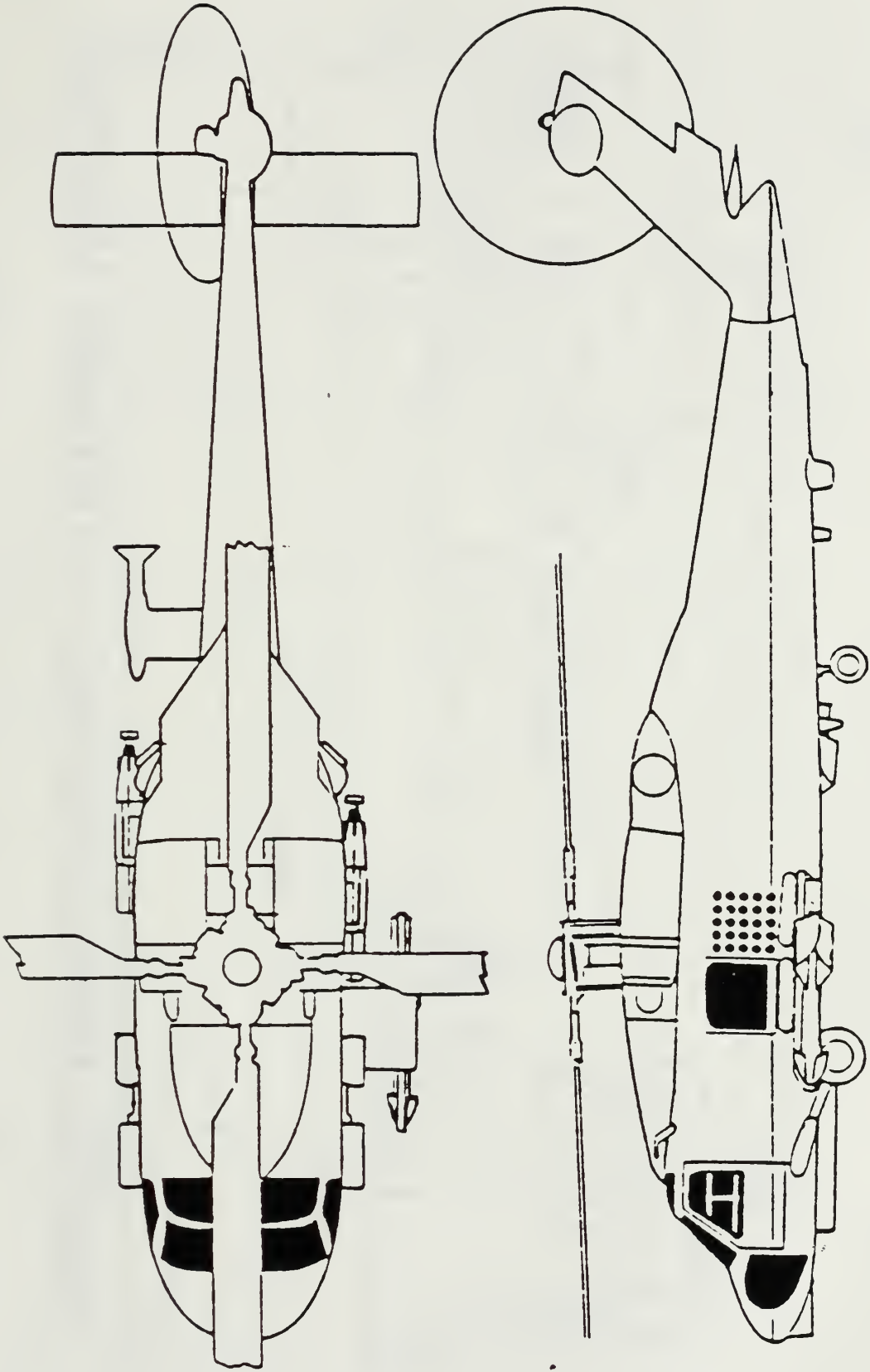
## APPENDIX A: ACRONYMS AND ABBREVIATIONS

- DOD	Department of Defense
- DODD	Department of Defense Directive
- DOD - STD	Department of Defense - Standard
- FAR	Federal Acquisition Regulations
- GATT	General Agreements on Trade and Tariff
- LCC	Life Cycle Cost
- MOU	Memorandum Of Understanding
- NATO	North Atlantic Treaty Organization
- OR	Operational Requirement
- PM	Program Manager
- RDT+E	Research, Development, Testing and Evaluation
- RNON	Royal Norwegian Navy
- RSI	Rationalization, Standardization and Interoperability
- US	United States
- USC	United States Code
- USN	United States Navy

# APPENDIX B: PENGUIN MISSILE DATA



## MISSILE CONFIGURATION



**HELICOPTER CONFIGURATION**





## LIST OF REFERENCES

1. John Roy Berquist, *Acquisition of Foreign Produced Products: A Government and Industry Perspective*, M.S., Naval Postgraduate School, Monterey, CA, 1979.
2. Edward M. Kaitz and Heinz M. Georges, *NATO RSI Policy: An Overview*, Edward M. Kaitz and Associates, Inc., Washington , D.C. 1980.
3. Department of Defense Directive 2010.6, "Standardization and Interoperability of Weapons within the North Atlantic Treaty Organization (NATO)", 5 March 1980
4. General Accounting Office, *Foreign Military Sales - A Growing Concern* , ID-76-51, 1 June 1976.
5. Meyer, Andres, "NATO Standardization and Defense procurement Statues", Congressional Research Service, Library of Congress, 26 January 1978.
6. Leonard Bridgeman, ed., *Janes All The Worlds Aircraft 1958-1959*, Marston and Conroy, LTD, London, England, 1958
7. John W.Taylor, ed., *Janes All The Worlds Aircraft 1986-1987*, Marston and Conroy, LTD, London, England, 1987.
8. Defense Systems Management College, "Remarks of President Jimmy Carter at NATO Ministerial Meeting", Defense Systems Management Review, Vol. 1, No.3 Ft. Belvoir, VA , 1977.
9. Daniel K. Malone, *Roland: A Case For or Against NATO Standardization?*, National Defense University, Washington D.C., May 1980.
10. James R. Golden, *NATO Burden Sharing: Risks and Opportunities*, Praeger Publishers, New York, New York 1983.
11. Ted Hooten, "Penguin: The Chick Which Joined the Eagles", Military Technology - MILTECH, v. 12, October 1985.
12. Mark Hewish, "Helicopter Launched Penguin for the US Navy", International Defense Review, v. 60, August 1985.
13. COMNAVAIRSYSCOM Memorandum, ser 3510, 35/5U5566, DTD 1 Aug 1985,



14. Department of Defense, "Memorandum of Understanding Between The Department of Defense of the United States as Represented by United States Department of the Navy and the Norwegian Ministry of Defense as Represented by the Royal Norwegian Navy Material Command Concerning the Adaptation, Test and Evaluation of the Penguin Missile System MK 2 for USN Helicopter Applications", Washington D.C. , 19 September 1986.
15. "Senate Trims Budget Request", Defense News, v.2, Oct 5, 1987.
16. Federal Acquisition Regulations, Vol. 1, 1986 ed.
17. "Industry Observer", Aviation Week and Space Technology, v.127, Nov 16, 1987.
18. Compendium of Authenticated Systems and Logistics Terms, Definitions, and Acronyms", AU-AFIT-LS-3-81, U.S. Air Force Institute of Technology, Wright Patterson AFB, Ohio, April 1981.

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